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ABSTRACT

This paper presents an overview of database tools that dynamically generate World Wide Web materials and focuses on the use of these tools to support research activities, as well as teaching and learning. Database applications have been used in classrooms to support learning activities for over a decade, but, although business and e-commerce have quickly embraced dynamic Web-based databases, their potential in educational environments is just beginning to be explored. The paper builds a theoretical framework for using Web-based databases to support constructivist learning and describes several applications of dynamic databases used to facilitate the construction of knowledge and support collaborative activities in online teacher education courses. Specific topics addressed include: trends in Web-based instruction and online courses; faculty concerns about developing Web-based courses; the student perspective; dynamic databases, including how a dynamic database works, features of Web-based databases, and the potential for dynamic databases in teaching and learning; and examples of dynamic databases, including student pictures and biographies for HyperGroups, a computer-based instruction database, and faculty feedback for student assignments. (MES)

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# Using Web Database Tools to Facilitate the Construction of Knowledge in Online Courses

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**Abstract:** This paper presents an overview of database tools that dynamically generate Web materials and focuses on the use of these tools used to support research activities as well as teaching and learning. Database applications have been used in classrooms to support learning activities for over a decade, but, although business and e-commerce have quickly embraced dynamic Web-based databases, their potential in educational environments is just now beginning to be explored. The paper builds a theoretical framework for using Web-based databases to support constructivist learning and describes several specific applications of dynamic databases used to facilitate the construction of knowledge and support collaborative activities in online teacher education courses.

## Trends in Web-Based Instruction and Online Courses

The acceptance of the World Wide Web as a legitimate teaching medium is undeniably making educators rethink how they design and deliver courses. As access to the Internet approaches a "universal" level in higher education, the number of online courses and course-related materials continues to grow. Universities are facing an increased need to produce online training and other instructional materials, to provide opportunities for life-long learning, and to compete with a variety of virtual content providers. Consequently, dramatic changes are occurring in the way education is delivered and shared. IBM Chairman and CEO Louis V. Gerstner Jr. (1996) stated "if one billion people are going to access education, universities are going to have to change the way they teach." How they might change will be explored in this article.

## Faculty Concerns about Developing Web-Based Courses

Faculty members at many universities have already begun to create and deliver online courses. These early adopters are testing and evaluating new models and methodologies, but, for the most part, no standardized paradigm for online course development has yet emerged. One of the reasons may be that faculty who create online courses are concerned about several issues related to this new way of teaching and are uncertain about how best to proceed. A major issue for many faculty is that creation of Web-based materials is time consuming and requires additional technology skills. Continuous updating of Web pages is necessary to keep content and links current as new material and resources become available.

Another issue is that faculty who want to create online resources themselves, will need access to adequate hardware and software as well as a robust, campus-wide electronic infrastructure. In other cases, faculty will need technical support services to assist them in the design and development process. Universities must find ways to provide multiple levels of support in order to maintain a dynamic university, one that can take advantage of the many technological changes that will continue to appear.

In addition to the need for technical support, faculty are also concerned about pedagogical issues that arise with online delivery. Designing a course to be delivered in a Web-based format requires a very different set of

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instructional strategies and philosophical orientations. Some faculty members see the Web as an opportunity for implementing instructional innovations (Khan, 1997; Owston, 1997), but most faculty are largely uninformed about the benefits and drawbacks of online environments and are unclear whether online courses are as effective as face-to-face courses at promoting and supporting student learning (Reeves, 1997).

If we compare the qualities and characteristics of a face-to-face class and an online class, one of the critical differences is the type of interactions that occur within the context of a course. Interaction in an online course occurs primarily through asynchronous and synchronous computer-mediated communication such as e-mail, listservs, and chat. It is the use of these communication tools that can often make the difference between a good online experience and one that falls short of its goals and does not engage students. Our focus, and one that we hope other faculty will adopt, is to encourage and facilitate meaningful interactions between students, faculty and the Web-based resources they encounter.

## Student Perspective

In addition to faculty needs and concerns, the needs of students also must be considered in the design and delivery of online courses. In order to build a true electronic community of learners, communication and collaboration among participants should be considered the driving force behind successful online courses. Unfortunately, many online courses (as well as many traditional courses) fail to take advantage of the potential for interactions that can add richness and depth to the construction of knowledge. In our online courses, student homework and projects are often similar to a face-to-face classroom; that is, specific assignments are given and students either post their work on a class listserv or e-mail it to the instructor to be graded. The problem, we have found, is that student work often does not become part of the course materials, and it tends to disappear at the end of the semester. Consequently, students do not always feel that they are participating in creating or adding to a body of knowledge and information for the course, nor do they experience ownership of the content.

Windschitl (1999) has stated that "constructivism is premised on the belief that learners actively create, interpret, and reorganize knowledge in individual ways." In that vein, we try to create a constructivist environment in our online courses, where students are able to manipulate the content of the course to fit their specific learning needs or goals. To do this, they must interact with the information they are researching and writing about, and they must share their views with the other students in the course, not just with the instructor. In a typical online course in our program area, there may be several hundred postings to the class listserv during the semester. Our efforts, therefore, have been toward having students not only interact with their own small number of postings, but use the virtual environment to explore, analyze, discuss, and debate issues and topics that cover the broad spectrum of information that arises during the course.

## Dynamic Databases

Most Web pages, including the course pages that we have been developing for several years, are static and do not take advantage of the interactivity offered by the Web. Most Web pages simply duplicate print-based materials in electronic form. Simply converting existing course information to online format is not enough to effectively produce meaningful Web-based courses. Online course developers must focus on creating courses that are more responsive to students and student needs, facilitating social and instructional interactions, creating a sense of a learning community, and delivering timely and useful information. Creative strategies are needed that utilize innovative tools such as Web database tools are needed.

### How a Dynamic Database Works

The integration of Web pages and dynamic database technologies allows users to access a database through a Web page and to dynamically generate Web pages that present the requested data. The variable data on the Web page is generated from the database and delivered to the user through a template page. All of the usual abilities of a database, such as searching for information, doing calculations, entering new information, and editing

existing information, are available through the Web browser. This means that any application that can be created using a database can be made available on the Web.

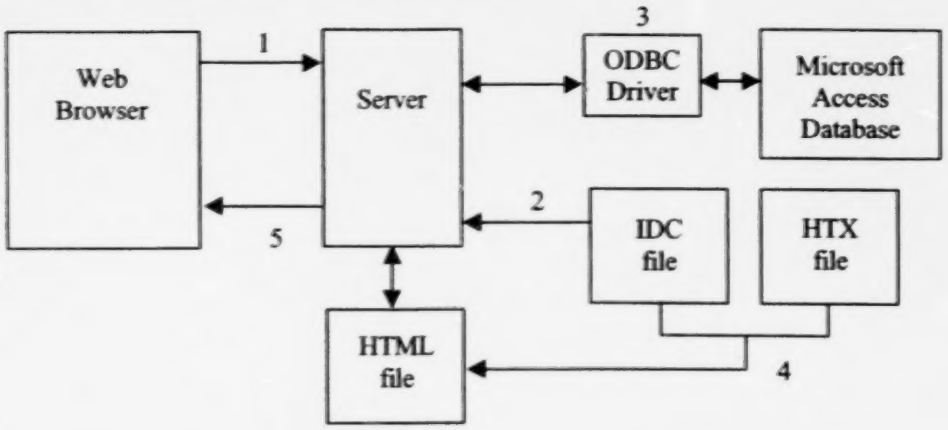


**Figure 1**: Diagram of Dynamic Web Page Generation Using IDC and HTX Files

1. Using a query form in a Web browser, the user makes a request to the server for an Internet Database Connector (IDC) file.
2. The server reads the IDC file that contains a query usually written in Simple Query Language (SQL). Other information may also be stored in this file, such as passwords and access to certain data.
3. The Internet Database Component of the server opens the database using the Open Database Connectivity (ODBC) driver and the IDC file information and runs the query to access the requested data.
4. The server merges the data from the database with a template file (HTX file) to produce a dynamic HTML document.
5. The server sends then the HTML file back to the user through the Web browser.

**Features of Web-Based Databases**

According to Inline Internet Systems, Inc. (1998), Web-based databases have several important features:

- Data is centralized and changes may be easily made without changing individual Web pages. This has the potential to reduce duplication and improve accuracy.
- Because the database information is changed through a Web-based form, it is not necessary for users to have the database software on their computers.
- Users do not need to have technology skills to add, revise, or use material in a database since it is driven through forms and search queries. This is particularly important for new or inexperienced users.
- The content in a database may be customized for delivery according to the user's country and language, time of day, and Web browser used.
- Databases created previously and used on one computer or through an intranet may be used to provide dynamic content.
- Because the database information has the potential to be accessed from anywhere in the world with an Internet connection and a Web browser, data can be expanded, updated or deleted easily.

**Potential for Dynamic Databases in Teaching and Learning**

Web-based database tools provide students and faculty with innovative solutions that promote collaboration and the creation of shared knowledge. Lynch (1999) summarizes this by stating, "To educational institutions this technology offers a challenge in using the technology to drive a more innovative and acceptable learning environment than that offered by the static Web pages of previous years. What is required now, is the classroom environment to adapt this technology into every day practice."

There are several advantages for using dynamic Web database tools:

- There is increased interaction between students and the resources. This interactivity implies involvement and commitment, since it empowers the user to control the environment.
- There is ownership of the material since the content is collective and not instructor-driven.
- The body of knowledge is not static but continues to change without requiring extra work on the part of the faculty member.
- Empowering students with control of content may affect participation, motivation and feeling of community. Material may become more interesting and stimulating when learner control increases.

## Examples of Dynamic Databases

### Example One: Student Pictures and Biographies for HyperGroups

Students in our online classes use a variety of listservs as a primary means of course communication. To enhance the feeling of an electronic learning community, students' pictures are taken at orientation and uploaded to the server. When a student posts a message to the listserv through a form that gathers their e-mail address, the message is displayed dynamically with their picture. The student simply has to type in their e-mail address for the picture to appear (See Figure 2).

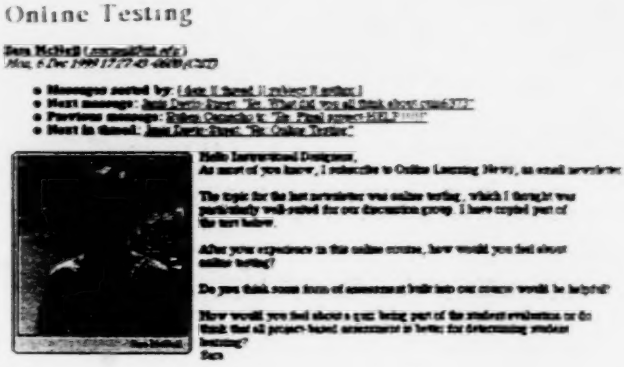


**Figure 2:** Participant's Pictures Automatically Generated by E-mail Address

### Example Two: Computer-Based Instruction Database

Students in a graduate level instructional design course use the Web database tools to contribute different types of materials. For example, with one assignment, students review an online tutorial and post an evaluation of it using a Web form. They are then able to search the tutorial evaluation database by content area and audience/grade level.

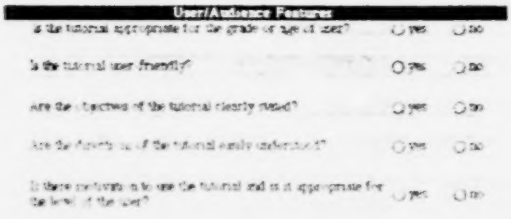


**Figure 3**: Form Used To Collect Tutorial Evaluation

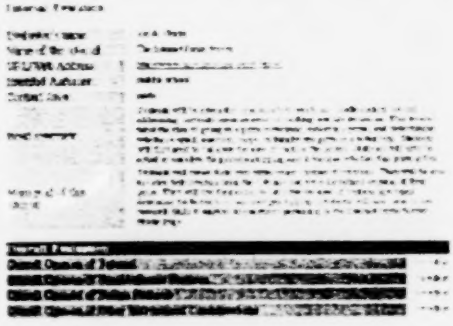

**Figure 4:** Dynamic HTML Page Generated From Database

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Perhaps the most interesting and creative use of a database is the game design assignment. Students design a computer-based game and submit their description as a newsletter article through a Web form.

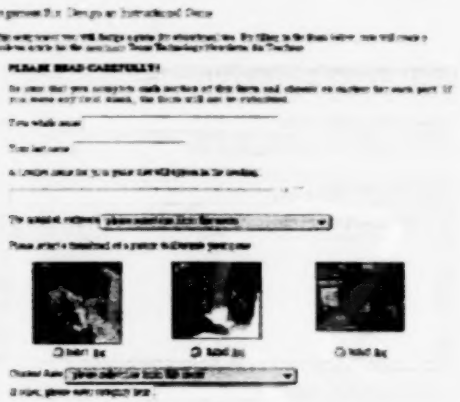

**Figure 5:** Form Used To Collect Game Design Data

**Figure 6:** Query Form to Select Game by Content, Audience or Author

Figure 5 illustrates the form used to collect data for the sections of the newsletter. Students use both text fields, pull-down menus, and radio buttons to submit information about the game they have designed. When the student submits the data, it is automatically sent to the database. Students may then use the query form (See Figure 6) to search the database by content area, audience, or author. The results of the query by content are shown in Figure 7. Figure 8 illustrates the merger of the content from the database with the newsletter template, the HTX file, which is then displayed in the browser as a dynamic HTML file, complete with banners and graphics (See Figure 8).

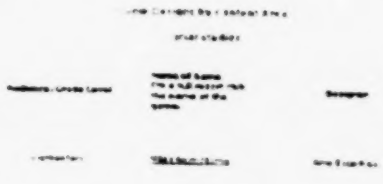

**Figure 7:** Results of Game Query

**Figure 8:** Example of Game Design in Newsletter Format

**Example Three: Faculty Feedback for Student Assignments**

In another online course, submission of student assignments also utilizes the Web database tools. Students are directed to a Web page that contains an online form in which they enter their name, a unique identification



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number (the last 4 digits of their Social Security number), and the number of the assignment (See Figure 9). They are also asked to copy and paste the question and then scroll farther down in the form and type in or paste in their answer. If they have created a word-processed document or a Web page in completing the assignment, an attachment feature may be used. Once the submit button is pressed, the student work is sent to the database.

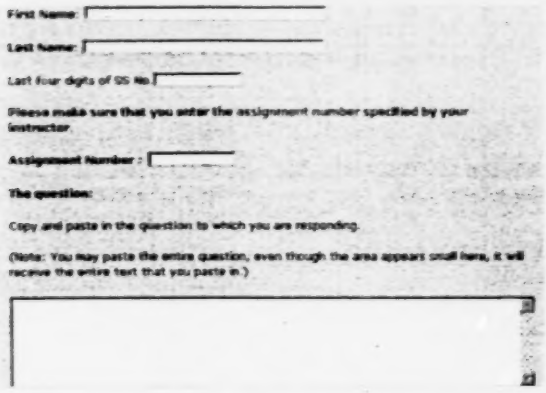
First Name:
Last Name:
Last four digits of SS No.
Please make sure that you enter the assignment number specified by your instructor.
Assignment Number :
The question:
Copy and paste in the question to which you are responding.
(Note: You may paste the entire question, even though the area appears small here, it will receive the entire text that you paste in.)

**Figure 9:** Student Assignment Submission Form

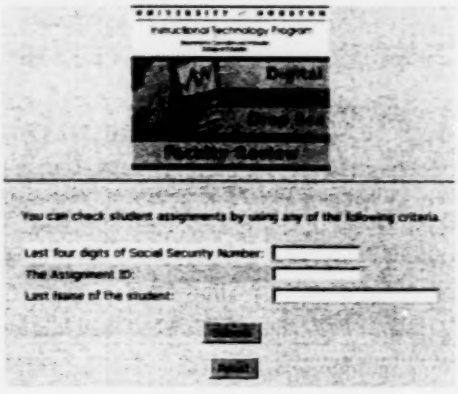
Instructional Technology Program
You can check student assignments by using any of the following criteria
Last four digits of Social Security Number:
The Assignment ID:
Last name of the student:

**Figure 10**: Faculty Review Form

After assignments have been submitted, the instructor uses the Faculty Review form to provide feedback for the assignments that have been posted (See Figure 10). Since all of the student postings are available in the database, the instructor may review all of a particular student's assignments or all of the postings on a specific assignment, depending on what terms are used to sort and view the database entries.

Students may also view the feedback by using the Student Feedback Review form. This page includes the questions, the answers, and the feedback in the order in which the assignments were posted (See Figure 11).

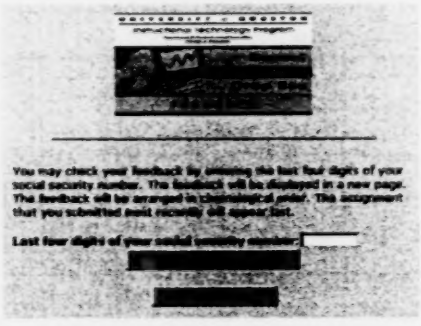

**Figure 11:** Student Feedback Review Form

## Conclusion

The use of dynamic database tools has helped us as we seek to improve our online courses, and they have indeed given students greater control over the information covered in the courses. However, there are some limitations that should be mentioned. First, the technical skills needed to develop and use the dynamic database tools are greater than those needed to create traditional Web sites. Many simple HTML editing tools are available, and converting word-processed files, for example, to static Web pages is a skill that may be mastered very quickly. Conceptualizing how the database tools will function is very different from creating static pages,


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and a new set of skills must be learned that include a greater understanding of information design and management. The time needed to design, develop, and evaluate online courses that include database tools requires a larger amount of both time and patience than many educators will be able to commit. Certainly, as with other Web-related tools, software improvements will make the job easier, but at this time, a steep learning curve is the rule. Finally, students who are asked to interact with these tools will need some instruction on how to use and access the interactive elements.

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